LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

MASTER

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MASTER'S FINAL WORK

INTERNSHIP REPORT

MODELING OF WORKERS' COMPENSATION INSURANCE UNDER IFRS17

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Acronyms and Abbreviations

LoB	Line of business
SLT	Similar Life Technique
NSLT	Non Similar Life Technique
SII	Solvency II
RM	Risk Margin
VA	Volatility Adjustment
MA	Matching Adjustment
LLP	Last liquid Point
UFR	Ultimate Forward Rate
IFRS 17	International Financial Reporting Standard
BE	Best Estimate
RA	Risk Adjustment
CSM	Contractual Service Margin
GoC	Group of Contracts
LIC	Liability for Incurred Claims
LRC	Liability for Remaining Coverage
FCF	Fulfilment Cash Flows
GMM	General Measurement Model
PAA	Premium Allocation Approach
VaR	Value at Risk
TVaR	Tail Value at risk
P&L	Profit & Loss
UPR	Unearned Premium Reserve
URR	Unexpired Risk Reserve
WC	Workers Compensation

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ABSTRACT

This work presents an analysis of how the new accounting regime IFRS17 will affect the calculation of Technical Provisions and performance for the Workers' Compensation Insurance line of business with a particular focus on the practical implementation issues. Comparisons with SII will be also provided.

A key feature that distinguishes this particular LoB in Solvency II is that liabilities are split between similar life techniques (SLT) and non-similar life techniques (NSLT) depending of the nature of the specific claim. This means that these two techniques will have to be analysed with the appropriate methodologies that separates the Life from the Non-life world.

In this paper the main focus is given to SLT techniques, and, in this contest, the new IFRS17 required concepts will be analysed.

To conclude, this notions will not be left only on a theoretical level but will be joined by a practical work that shows the challenges of implementing IFRS 17 concepts in one specific Solvency II model and the solutions that were implemented to achieve a fair balance between the theoretical concepts and the actual implementation of them.

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1. INTRODUCTION

The following report is a result of a six-month Internship in Addactis Iberica SA undertaken in their Lisbon department. Addactis Iberica is a consultancy company that provides risk and actuarial solutions for Insurance companies and helps them with their specific goals.

Addactis, more precisely, combines the IT requirement through its own software development with the actuarial expertise provided by the consulting teams. Every software is designed to provide solutions for different tasks that are required by actuarial or risk departments.

The internship was divided in two parts: The aim of the first part was gaining confidence with Addactis actuarial software. To cover this aspect the company gave me tutorials to be made during the internship.

The tutorials have been very useful to have a better idea of the different Software environments that allowed me to have the practical knowledge of the different tools that the Addactis Software provides.

Once I had the right handling of the software, I could advance with the second part of my internship. In this part I had to deal with the main topic of my internship, indeed, I had to study the impact of the IFRS 17 on the Workers Compensation Line of business with a particular reference to the SLT part.

In the first part of the internship report, I will analyse the theory behind IFRS 17 and its principal components with a particular focus on the RA methodology. Proper comparisons with the Solvency II regime will be also provided. This part will focus on a more theoretical level, but, however fundamental to have a correct understanding of the following parts.

In the second part, I will analyse the Workers Compensation LoB, with an in-depth analysis of the situation in Portugal. The different types of liabilities that arise within the SLT LoB will also be explained with a special focus on the differences/analogies between them.

Before starting with the specific parts of my internship report, I think, that a further and brief explanation about the practical approach and the general lines that followed, is due.
To study properly the SLT products, a specific model called *"SLT annuity model"* was built.

The *SLT annuity model*, just mentioned, was already developed properly for Solvency II calculations, indeed the best estimates for the central and stressed scenarios for the different inherent risks were already computed.

My goal, with the help of my colleagues, was to update the model for the new IFRS 17 requirements, we had to change the way the shocks were computed and we had to deal with the new concept of Risk adjustment that was not contemplated in Solvency II.

Moreover, I want to add the fact that my research was just a part of a bigger part of the company project that comprises also the NSLT part and the measurement part in IFRS 17.

Overall, and in the perspective of a Master's Final Work, this internship report combines the theoretical knowledge acquired during the master, especially regarding Solvency II, IFRS 17 and Life calculation techniques, and an anticipation of the market's needs with an application in the Portuguese context.

2. ANALYSIS AND COMPARISON BETWEEN IFRS 17 AND SOLVENCY II

2.1. Main target and goals of the two regimes

The insurance industry fulfils a fundamental role in the global economy. Insurance companies enable people and companies to transfer risks. Insurers, with 13 trillion in assets, count for 12% of total assets listed in IFRS standards.[1]

Insurers, for the nature of their business, are exposed to many risks. The company's financial health affects the global economy. Hence financial statements need to reflect properly insurance risks, and changes in those risks, in a timely and transparent way.

In the previous Standard IFRS 4, companies were not required to account for insurance contracts in one specific way. Instead, insurance contracts were accounted for differently across jurisdictions and may even be accounted for differently within the same company.

Furthermore, many insurers' financial statements lack regular updates of the value of insurance obligations to reflect changes in economic environment.

Moreover, with existing accounting for insurance contracts, investor and analysis find difficult to:

1. Identify which groups of insurance contracts are profit making or loss making and
2. Analyse the trend information about insurance contracts

The aim of IFRS 17 was to address all these inadequacies in insurance accounting practice. It requires, indeed, that all insurance companies be able to reflect the real economic changes in financial statements, resulting in an increase of global comparability and improving the quality of financial information and contributing to long-term financial stability.

Particularly, the International Accounting Standard Board issued IFRS 17 in May 2017. IFRS 17 sets out the standard that a company should apply in reporting information about insurance contracts it issues and reinsurance contract it holds.

IFRS 17 is effective from January 2023 and replaces an Interim *Standard- IFRS 4 Insurance contracts.*

IFRS 17 is the first comprehensive and truly international IFRS Standard establishing the accounting for insurance contracts.

Moreover IFRS 17:

1. Provides updated information about the obligations, risk and performance of insurance contracts,

2. Increases transparency in financial information reported by insurance companies, which will give investors and analysts more confidence in understanding the insurance industry;

3. Introduces consistent accounting for all insurance contracts based on a current measurement model.

[1] International Accounting Standard Broad®. (May 2017)**.** *IFRS-17- Effect- Analysis*

The Solvency II regime, on the other hand, has been in force since 2016 and introduces for the first time a harmonised, sound and robust prudential framework for insurance firms in the EU.

It is based on the risk profile of each individual insurance company and seeks to promote comparability, transparency and competitiveness.

The previous regime, Solvency I, showed certain structural weaknesses: It was not risk-sensitive, and a number of key risks, including market, credit and operational risks were either not captured at all in capital requirements or were not properly taken into account.

All that caused several issues like over simplistic models, wrong intervention time by supervisor and sub-optimal capital allocation in terms of risk and return of shareholders.

In addition, the 2007-08 subprime crisis highlighted the need to review the European Union supervisory model for the financial sector: different supervisory organisms were established for Macroprudential supervision (ESRB) and Microprudential supervision (EBA, EIOPA, ESMA). Each with a respective role and function.

The Solvency II framework is divided into 3 pillars:

- Pillar 1 sets out quantitative requirements, including the rules to value assets and liabilities (in particular, technical provisions), to calculate capital requirements and to identify eligible own funds to cover those requirements;

- Pillar 2 sets out qualitative requirements for risk management, governance, as well as the details of the supervisory process with competent authorities; this will ensure that the regulatory framework is combined with each undertaking's own risk-management system and informs business decisions;

- Pillar 3 addresses transparency, reporting to supervisory authorities and disclosure to the public, thereby enhancing market discipline and increasing comparability, leading to more competition.

Comparing IFRS 17 and Solvency II on a high level, both frameworks adopt a Market consistent measurement approach. The differences that exist in the detailed requirements of the two frameworks reflect the objectives and scope of the two respective regimes.

IFRS 17 deals with reporting the rights and obligations from insurance contracts in the context of general-purpose financial reporting, i.e. reporting of information to the financial markets.

Doing that, IFRS17 is indeed targeting the valuation and performance of the Insurance contracts and within that, the valuation of Technical Provisions.

Solvency II, on the other hand, focuses on the valuation of insurance obligations within a risk-based framework with the protection of policyholders and beneficiaries at its heart.

Solvency, anyway, covers not only aspects relating the valuation of Liabilities but the Regime itself also covers many other aspects like valuation of assets, Economic Balance Sheet, and an attempt to analyse and measure all the standard risks that (re) insurance companies are exposed to.

2.2. Valuation of liabilities in IFRS 17 and Solvency II

In this part the analogies/differences in the computation of insurance liabilities in the two regimes will be analysed.

First, the requirements on the aggregation of insurance contracts in IFRS 17 will be handled through the definition of GoC and contract boundaries.

I will also shortly introduce the two types of liabilities that are present in IFRS 17 (Liability for incurred claims, Liability for remaining coverage) as well as the estimates of fulfilment cash flows (expected value of future cash flows, discount rate, Risk adjustments) plus CSM, and their corresponding items in Solvency II regime (best estimate, risk margin).

All these terms will be only introduced in this section and will be further analysed in their dedicated sections in chapter 2.

We will refer to them also, in chapter 3, where we will see how the choice of different measurement methods can influence the calculation of liabilities and consequently change or improve the process.

Figure 1 below identifies the relationship between the different elements.

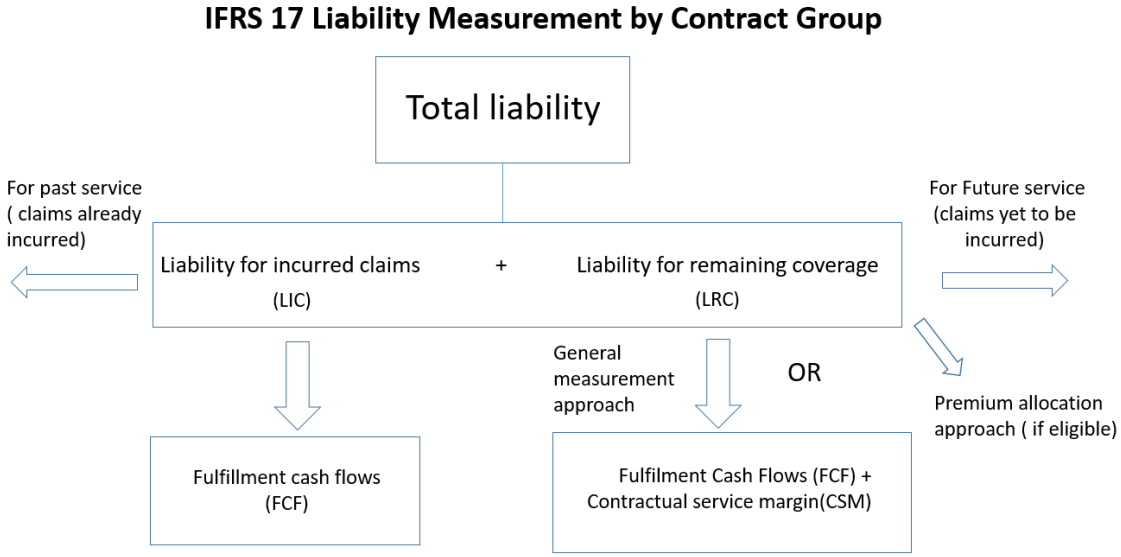

Figure 1 - IFRS17 Liability measurement diagram[2]

i. Group of contracts

Insurance companies underwrite large numbers of similar contracts to pool risk. For this reason, the IASB has introduced IFRS 17 guidelines for contract aggregation in the calculation and adjustment of the Contractual Service Margin (CSM).

The objective of this grouping, for insurers, is to analyse the profitability. The guidelines, in this context, seek to take into account similar risks avoiding mixing profitable contracts with unprofitable ones inside the same GoC.

[2] MOODY'S Analytics®. *IFRS 17 Implementation: Best Practices and Opportunities*

The right definition of a GoC takes a fundamental role in the evaluation of the "profitability level" of the contracts and the computations of CSM.

In IFRS 17 the present value of future cash flows is required at the Group of Contract level. The criteria used to set the minimum aggregation level for contract groups are:

- Portfolio level – contract groups should contain contracts within a product line with similar risks that are managed together.
- Cohort – contract groups should contain contracts that are issued no more than one year apart.
- Profitability level – contract groups should distinguish between contracts that are:

    - Onerous at initial recognition, or
    - At initial recognition have no significant possibility of becoming onerous, or
    - Remaining contracts (i.e. neither of the above).

We will focus, in this part on these last two points: the Cohort and the Profitability level criteria.

The rational reason for the division in annual cohorts is that usually economic circumstances and profitability may change, or the insurer may modify the price of the contract from one year to the other. We refer to it as "annual cohort" but we can also refer also to shorter periods, let's say quarterly.

Finally, the last point is the most challenging part for insurance companies but is also one of the most relevant aspects to take into account at initial recognition.

The IFRS 17 standard requires separate reporting of onerous groups from profitable groups; the time of recognition of onerous groups will affect the liability value. Contracts are considered onerous at initial recognition, if the fulfilment cash flow arising from the contract is a net outflow.

In this case, the insurer recognizes an immediate loss in the financial statements and a CSM of zero is established.

The CSM is, indeed, the expected unearned future profit to be recognized as services are provided. If a contract is onerous no unearned profit will arise and the concept of CSM will be zero.

It is the responsibility of each insurance company to determine the potential profit/loss of each contract. The most used methodology is called "profitability /onerous test" that could be based on the sensitivity of the profit on the assumptions used, and on internal reporting information based on experience.

The Solvency II regime allows the allocation of contracts to a LoB that corresponds to the minimum level of segmentation, with a specific separation into life/non-life products.

Moreover, inside a Solvency II LoB, insurance companies may identify homogeneous risk groups (HRG), if needed, similar to the"portfolio level" used in IFRS 17. In any case there is no strict and detailed definition of GoC as in IFRS17.

ii. Contract boundaries

The boundary of a contract represents the point beyond which the policyholder no longer has substantive rights under the contract, and the insurer no longer has a substantive obligation to provide services. Any cash flow beyond the boundary are not recognised in the measurement of the liability.

Like shown in figure 2:

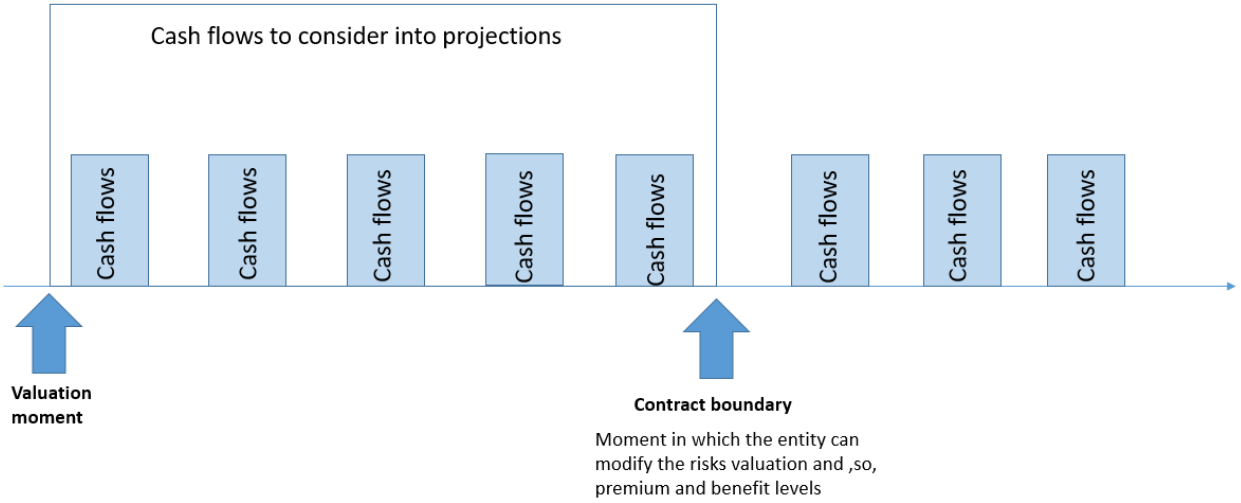

Figure 2 - IFRS17 Contract boundary explanation diagram[3]

Here IFRS 17 definition of contract boundary is proposed while SII contract boundary regulation will be left in the appendix C.

IFRS 17 defines contract boundary as follow:

"*Cash flows are within the boundary of an insurance contract if they arise from substantive rights and obligations that exist during the reporting period in which the entity can compel the policyholder to pay the premiums or in which the entity has a substantive obligation to provide the policyholder with services. A substantive obligation to provide services ends when:*

a. The entity has the practical ability to reassess the risks of the particular policyholder and, as a result, can set a price or level of benefits that fully reflects those risks; or

b. Both of the following criteria are satisfied:

i. The entity has the practical ability to reassess the risks of the portfolio of insurance contracts that contains the contract and, as a result, can set a price or level of benefits that fully reflects the risk of that portfolio; and

[3] Deloitte®.(June 2019). *Formación IFRS 17*

ii. The pricing of the premiums for coverage up to the date when the risks are reassessed does not take into account the risks that relate to periods after the reassessment date." [4]

Definition could differ between each regime, anyway EIOPA gave his view: *"Even though Solvency II uses slightly different wording than IFRS 17 to express the objective, one cannot expect material differences to the resulting contract boundaries, other than in circumstances where the insurer has the legal right to reprice the premium for the re-assessed risk, but can reasonably justify the insurer does not have the practical ability to reprice."*[5]

iii. Estimates of future cash flows

IFRS 17 requires insurance companies to estimate future cash flows: fundamental to recognize the future profits derived as the difference between future inflows (premiums, recoverable) and future cash outflows (indemnity payments and benefits, direct and indirect expense, taxes and charges levied on policyholders).

Like we saw in the paragraph above, only cash flows within the contract boundaries should be considered.

Estimates should be:

- Unbiased, current and explicit
- Include all information on amount, timing and uncertainty of cash-flows

In Solvency II the same technique is known as "the best estimate "calculation.

Solvency II's BE represent the value of all future cash flows related to the past, present and future of existing contractual obligations. These cash flows are composed of all future claims payments, allocated and unallocated expenses and expected future premiums related to policies in force.

The calculation of the BE should be obtained by taking into account the uncertainty of future cash flows. Moreover, will be affected by the type of insurance products we are dealing with and could be measured with Life, Non-life, or a mix of both techniques.

iv. Discount rates

The discount rate applies to the estimate of future cash flows and it reflects the time value of money of the cash flows and liquidity characteristics of insurance contracts. In IFRS 17 it should reflect, explicitly, the financial risk for instruments whose characteristics are consistent with insurance contracts.

In IFRS 17, two general approaches are used to determine the right interest rate to apply:

- Top-down approach
- Bottom-up approach

In Solvency II, instead, the present value of future cash flows is done by using the risk-free interest rate structure, given by EIOPA.

[4] IFRS17 CSM Working Party. (November, 2019). *Determining contract boundary under IFRS17*
[5] EIOPA's analysis of IFRS 17 Insurance Contracts, October 2018

Certain adjustments can be applied in some situations in Solvency II, in particular:

- Volatility adjustment
- Matching adjustment

Both, IFRS 17 and Solvency II methodologies will be analysed in chapter 2.3

v. Risk adjustment

Risk adjustment is a specific element in IFRS 17 that represents the compensation required by the insurer for bearing the uncertainty about the amount and timing of cash flows that arises from non-financial risk.

The different methodologies will be further analysed in chapter 2.4. In particular, the one that relates with the practical research: the VaR approach.

Also, comparisons with the risk margin in Solvency II will be further discussed.

2.3. Discount rate in IFRS 17

IFRS 17, like we explained before, allows to two different approaches to construct the discount rates. The two approaches (bottom-up/top down), do not necessarily produce the same result, like is shown in figure 3:

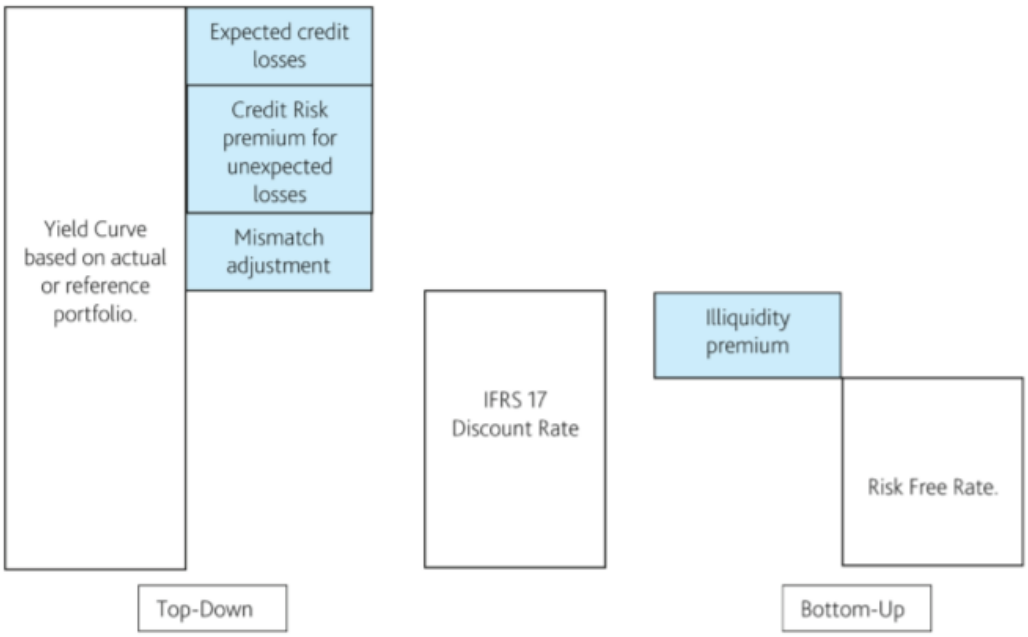

Figure 3 - IFRS17 Yield curve construction approaches[6]

[6] MOODY'S Analytics®, *IFRS 17 Discount rate*

2.3.1. Analysis and comparison between bottom-up/top-down approaches

i. Bottom- up method

A fully liquid risk free yield curve is the foundation for the 'bottom-up' approach outlined in Figure 3. IFRS 17 does not define a specific risk free yield curve to derive. Usually, insurers define the curve using government bonds or inter-bank swap rates.

An addition to this curve is made to reflect the differences between the liquidity characteristics of financial instruments and the liquidity characteristics of the insurance contracts.

Usually the assets composing the risk-free yield curves are traded in deep and liquid markets. For this reason, investors are able to rapidly sell the assets without incurring additional cost.

Policyholder, instead, are not able to trade their policies for different reasons like surrender penalties or minimum guarantee returns. Moreover, insurance companies can't be forced to do earlier payments. Therefore, due to these *"source of illiquidity"* insurance contracts tend to be less liquid than financial instruments.

ii. Top-down method

For the "top-down" approach insurers may use a reference portfolio of their own assets or a hypothetical asset portfolio which matches the characteristics of insurance contracts.

Discount rates that represent the market implied yields of a reference portfolio of assets, are adjusted downwards to eliminate any components of the reference portfolio yield that are not consistent with the characteristic of an insurance contract (credit risk). After that insures make an adjustment for asset liabilities mismatches.

For this reason, under a top down approach insurers will need to decide a methodology to remove from the market rate of return any element that is in respect of credit risk.

iii. Comparison with discount rate in Solvency II

As mentioned before, in Solvency II, in order to calculate the BE of an insurer liabilities the discount rate applied is the risk free interest curve given by EIOPA. The curve is generally obtained based on interest rate swaps, adjusted to eliminate the credit risk.

The curve should be extrapolated using data from a deep, liquid and transparent market. The LLP (last liquid point), in this sense, is the last point in the curve where data seem to have the characteristics described above. In the case of Euro the LLP is 20 years.

After that is decided that the curve will reach the UFR (ultimate forward rate) with a certain speed of convergence, that in our case is 40 years.

The two most common adjustment applied on the interest rate curve will be analysed below.

iv. Volatility adjustment

The Volatility Adjustment (VA) is a constant addition to the risk-free curve, It is designed to protect insurers with long-term liabilities from the impact of volatility on the insurers' solvency position.

The VA is based on a risk-corrected spread on the assets in a reference portfolio. It is defined as the spread between the interest rate of the assets in the reference portfolio and the corresponding risk-free rate, minus the fundamental spread (which represents default or downgrade risk).

The VA is provided and updated by EIOPA and can differ between currencies and countries. The VA is just added to the liquid part of the risk-free zero-coupon rates, i.e. until the so-called Last Liquid Point (LLP). After the LLP, the curve converges to the UFR.

v. Matching adjustment

The MA, instead, is an upward adjustment to the entire risk-free term rate curve and it has the same purpose of the VA. Although the MA is usually higher than the VA, it could become negative.

Finally, the MA is not always available but has to be applied only to specified identified portfolios. For example, if insurers have long predictable liabilities and can hold matching assets to maturity, are not exposed to the risk of changing spreads, they may be allowed to adjust the risk-free discount rate.

Those adjustments applied to the discount rate will lead to a lower value of the technical provisions, consequently a higher value of own funds (excess of assets over liabilities).

2.4. Risk adjustment in IFRS 17

Risk adjustment corresponds to the compensation that an entity requires for bearing uncertainty about the amounts and timing of cash flows related to non-financial risks in insurance contracts.

IFRS 17 emphasizes the need to separate insurance risks (longevity risk, lapse risks, expense risk) from financial risks (market risks, credit risks) involved in determining the RA and BE respectively, like shown in figure 4:

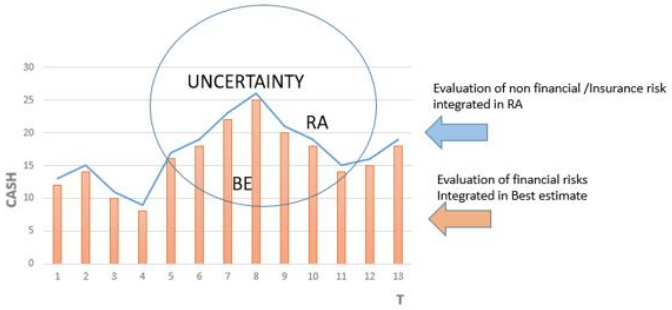

Figure 4 - IFRS17 RA/BE diagram[7]

In the calculation of RA no specific method is prescribed, anyway, there are some qualitative principles that should be taken into account

- Risk of low frequency and high severity should lead to a higher level of RA than risks of high frequency and low severity,

[7] Addactis®. (June 2019). *Volada_Paper_Addactis_IFRS_17_Risk_Adjustment*

- For similar risks, a contract having a longer duration must lead to a higher RA,
- The RA must be increased according to the thickness of the distribution tail of the underlying risk,
- The less information is available of the estimation of liabilities and possible underlying trends, the higher the RA must be,
- As the progressive acquisition of information reduces the uncertainty about the amount and payments date of future flows, the RA must decrease accordingly.

There are also, other important considerations that will be relevant to an entity to set the risk adjustment:

- Consistency on how the insurers assess risk from a fulfilment prospective approach
- Practicality of implementation and ongoing re-measurement
- Translation of the RA for disclosure of an equivalent confidence level method

Several methods are potentially available, although their usage should meet the criteria above, given the specific circumstances of the company. Potential methods are quantile techniques like VaR or TVaR, CoC technique, or scenario modelling also could be used. In paragraph 2.4.2 some of them will be analysed with more details.

2.4.1 *Diversification and Risk adjustment allocation issues*

One of the key aspects of the risk adjustment is that to reflect the benefits of diversification between the insurance risks and liabilities portfolios in the valuation of the RA.

Diversification, can occur because of whole or partial independence:

- Between risks
- Between collection of contracts

IFRS 17 requires that contracts within a portfolio have similar risks are managed together. So, diversification between similar risks and contracts should be included. Moreover, since the RA is implicitly linked to CSM calculations, and these are computed at the GoC level, the RA, has to be computed at the same level of granularity (although may be consolidated at higher level). Like shown in figure 5:

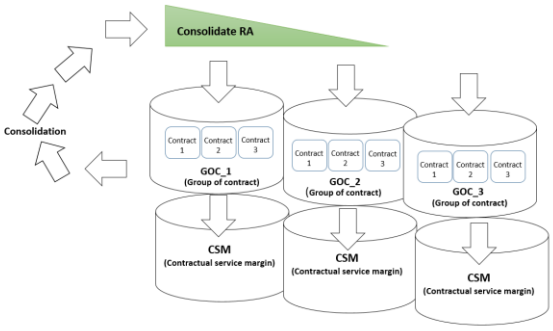

Figure 5 - Relationship between RA and CSM[8]

[8] Addactis®. (June 2019)*Volada_Paper_Addactis_IFRS_17_Risk_Adjustment*

There are two methodologies to get the Risk adjustment at the GoC level: the Bottom- up contract group approach and top-down aggregate approach.

i. Bottom- up contract group approach

We define a bottom-up approach as an approach where the risk adjustment calculations are carried out at IFRS 17 Group of contract level directly.

The advantage is, having, a RA directly at the GoC level without intermediate calculations, this produce a faster and easier comprehension. The main problem with this approach is that does not allow for diversification between contract groups.

This means, that the risk adjustment for any collection of Group of contract is the sum of risk adjustment for each contract group. The diversification benefit could be small with contract groups of the same product type, but larger across different product types producing a risk adjustment that is potentially overestimated.

ii. Top-Down aggregate approach

A top-down approach is used when the risk adjustment calculation is performed in aggregate across different IFRS 17 contract groups of a particular entity or fund. Implicitly, it will include an allowance for the diversification between the contracts.

So after a global computation of the RA an allocation method for each contract group is required.

One of the most used and simplest method is the scalar allocation. Under the scalar approach the aggregate risk adjustment is allocated in proportion to the reference measure.

A reference measure could be everything available at GoC level like the expected present value of future cash-flow. It is important to mention that the use of this element can lead to negative values and in those cases, we need to find an alternative to provide the allocation of the RA that cannot be negative by definition.

2.4.2 Risk adjustment calculation methodologies

i. Value at Risk

The Value at Risk approach is used for the Standard Formula Solvency Capital Requirement calculation under Solvency II and frequently used for internal economic capital calculations.

For both the Standard Formula and Internal Models, the calculation covers all risks and the confidence level for the required capital is set at the 99.5th percentile over a one year time horizon.

For IFRS 17, the confidence level is defined by the single insurer at xth percentile over the iabilities total projections horizon.

The VaR approach can be summarized as follows:

- The entity determines the target confidence level at which it determines its compensation required, xth percentile
- VaR is determined such that the probability of actual fulfilment cash flows being less than VaR is x%
- Risk adjustment is then determined as VaR @xth percentile less the mean of present value of probability-weighted cash flows

ii. Conditional tail expectation (CTE)

The Conditional Tail Expectation (CTE) approach can be summarized as follows:

Entity determines the target confidence level at which it determines its compensation required, e.g., xth percentile.

• From the probability distribution, an entity can determine:

- (A) Conditional mean of the fulfilment cash flows beyond the target percentile o
- (B) Mean of present value of probability-weighted cash flows

Risk adjustment is then determined as the difference between A and B

2.4.3. Comparison between RA and risk margin

Despite the conceptual proximity of the concept of RA and Risk margin, they have several differences. The table below will summarize these differences:

TABLE 1 - COMPARISON BETWEEN RISK ADJUSTMENT AND RISK MARGIN[9]

ITEMS	RISK ADJUSTMENT	RISK MARGIN
Underlying economic principle	Requires for bearing the uncertainty about the amount and timing of the Cash Flows that arises from non-financial risks	Estimated based on the transfer of all insurance liabilities to another insurance undertaking
Methodology	No method specified; however, confidence level associated with the RA must be provided in all cases	Cost of capital method
Parameter setting	Confidence level, risk measurement and methodology to be defined according to the risk aversion of the insurance entity	Cost of capital rate set at 6 % and applied to the net present value of the prospective SCRs underlying calculation. 99.5% confidence level implicit in the calculation of SCRs
Risk horizon	Must cover the duration of liabilities	One-year vision
Risk perimeter	Non-financial risks related to insurance contracts	Underwriting, counterparty, and operational risks (for NL business where Market Risk can be considered negligible)
Granularity	Portfolios x Group of contracts	Lines of business

[9] Addactis®. (June 2019)*Volada_Paper_Addactis_IFRS_17_Risk_Adjustment*

3. IFRS 17 MEASUREMENT MODELS

After having analysed, in the previous chapter, the fundamental elements present in IFRS 17, this chapter will be focused more on how the valuation of liabilities could change based on the different measurement method applied.

Before starting to present the different measurement models that exist in IFRS 17, it is important to have clear in mind the difference between initial and subsequent recognition.

i. Initial recognition

On initial recognition, an entity shall measure a group of insurance contracts at the total of: FCF (BE, RA, Discount rate) and CSM.

In this case, the reporting date is equal to the start of the insurance contract coverage period. The company doesn't have to take into account past claims but has just to focus on unexpired risks (LRC). Like shown in next figure

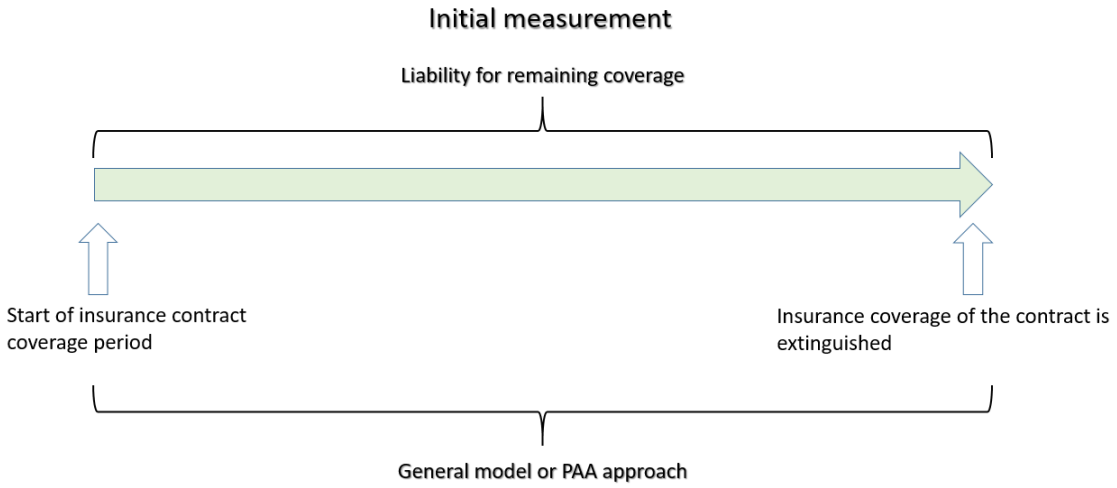

Figure 6 - Initial measurement evaluation liabilities diagram

ii. Subsequent recognition

The carrying amount of liability for a group of insurance contracts at the end of each reporting period should be the sum of:

- Liability of remaining coverage comprising:
    - The fulfilment cash flows related to future services allocated to the group at that date
    - The contractual service margin of the group at that date.

- The liabilities for incurred claims, comprising the fulfilment cash flows related to past services allocated to the group at that date.

The image summarizes this concept:

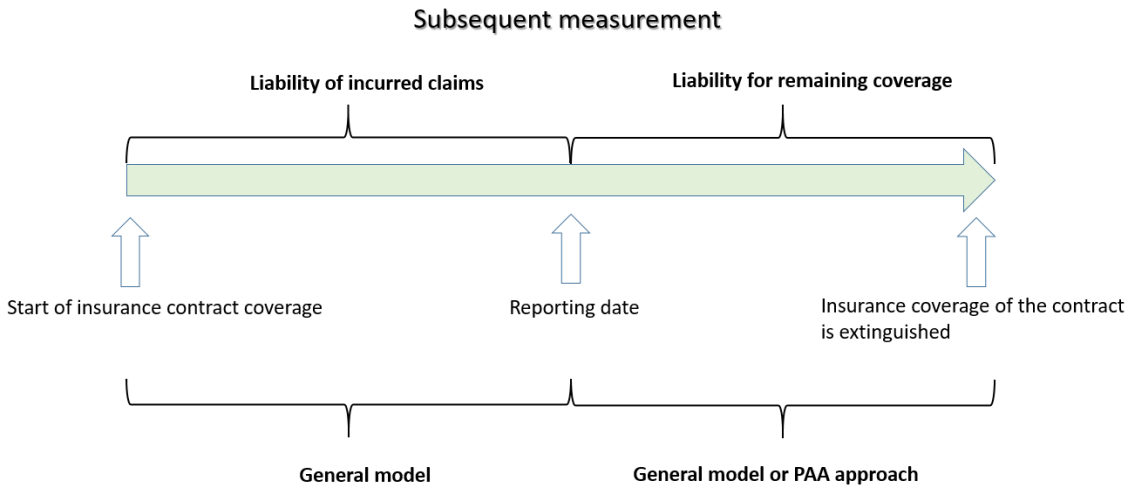

Figure 7 - Subsequent measurement evaluation liabilities diagram

Like shown in the image below, there are two different models to measure liabilities in IFRS 17: GMM and PAA.

The differences between these two methods are shown in the image below and will be further analysed in the next chapters.

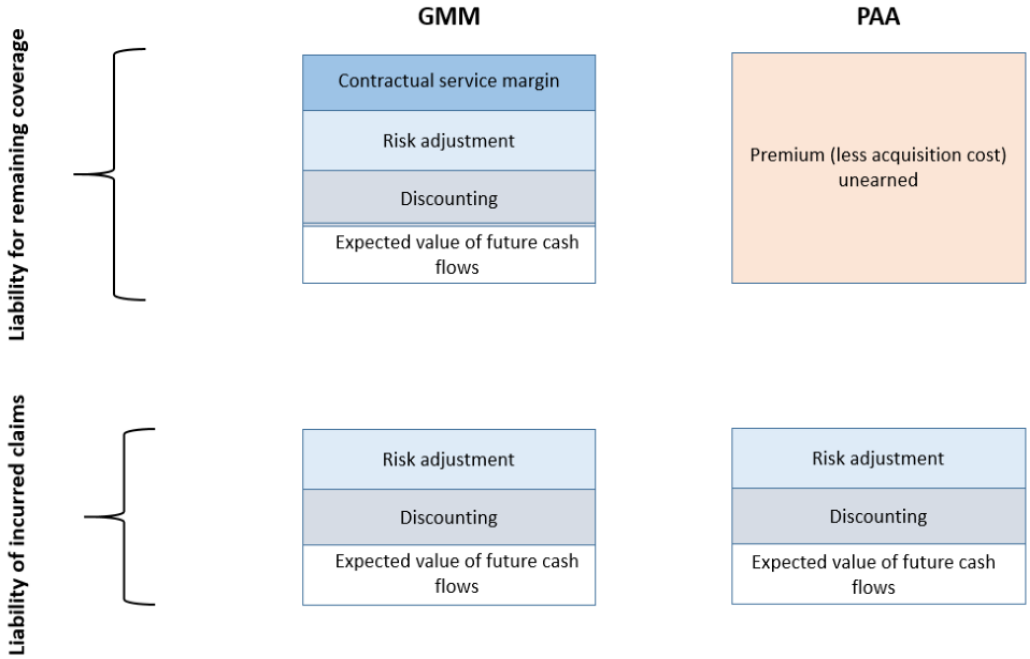

Figure 8 - Comparisons of liability computations between GMM and PAA

For completeness of information, another approach called “VFA”, may be used, especially in Life-business, but will not be treated in this report.

3.1. GMM model

The general measurement model applies to all insurance and reinsurance contracts with periods longer than one year, which have direct or indirect participation. If an insurance company chooses not to use the GMM then it will have to justify that choice and for many contracts will be the only option.

The GMM is sometimes called the Building block Approach. This is because the measurement of an insurance contract is broken into a number of blocks that are the FCF (Expected value of future cash flows, Discount rate, RA) plus the concept of CSM for the future business.
A practical example of valuation of CSM under the GMM model is given in the image below.

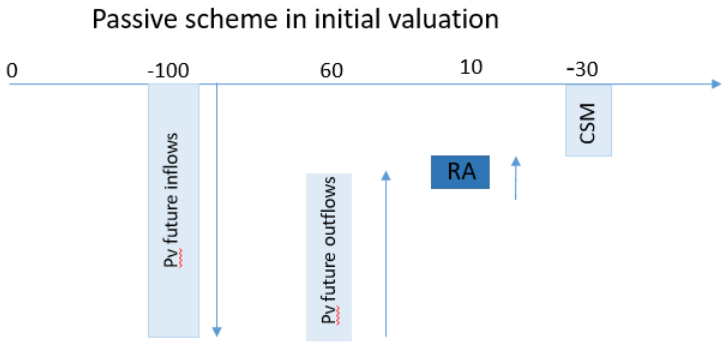

Figure 9 - Practical example of CSM computation at initial valuation[10]

In the image above the Present value of future inflows (-100), PV future outflows (+60) and RA (+10) lead to a contract that is profitable (-100+60+10= -30), CSM exist and must be equal to the value that gives rise to a null profit at inception (+30 in our case).
In the case the Present value FCF>0, the contract is considered onerous: the value that exceeds must be entered in the P&L calculation.

During the subsequent measures, the CSM, if exists, it will change based on actuarial assumptions (Lapse, Mortality, Longevity Acquisition costs, Administration costs). It will be adjusted annually based on changes in future cash flows and RAs. When the CSM zeroes, finally, the estimation of future cash flows will be recognized in P&L.

To conclude, if changes are favourable the CSM will increase without a specific limit, instead, in a presence of unfavourable changes it will not be negative: the resultant amount will be taken in the P&L calculation.

Is interesting to observe that while SII automatically assumes that it is already in the P&L within the Own Funds (implicitly) in IFRS17, we create this new liability to account for a profit that cannot be considered "earned" until we provide the service.

[10] Deloitte®.(June 2019). *Formación IFRS 17*

3.2. PAA model

The PAA approach does not use the CSM concept. The liability for Remaining Coverage is instead based on the premium received and passage of time or another driver.

The insurer is not required to create a view of all future cash flows instead the initial insurance asset on initial recognition is simply any premium received in the period. Note this is a not a view of all future premiums under the contract but only the premium received in the period.

This asset can be reduced by any acquisition costs. The liability for Remaining Coverage is then the opposite sign of the premium, less any acquisition costs.

To use this method, some requirements must be met:

- An entity has to justify that the result obtained in the computation under PAA approach should be similar to the one under GMM
- Contracts shouldn't exceed one year duration coverage
- Contracts should be profitable (an onerous test could be required)

From the nature of this approach, it seems evident that it will be used by many companies that operate in the Non-life sectors. The calculation of RA and CSM could not be so straightforward and many companies will try to avoid that complication, using instead the PAA.

4. WORKERS' COMPENSATION LINE OF BUSINESS

Since 1913, employers have been obliged in Portugal to insure the consequences of accidents at work suffered by their employees. In this context, the legal obligation of insurance for the risk of accidents at work was established, with the aim of ensuring that employees and their families have adequate compensation for damages arising from accidents at work.

An accident at work, more precisely, is one that occurs in the workplace and during working hours, producing bodily injury, functional disturbance or illness resulting in reduced work capacity, or income, or death.

The legal regime of Workers compensation, in Europe, is usually managed by national social security while in Portugal it is based on the subscription of a private compulsory insurance with private entities, the insurance companies.

Regardless of the private nature of this LoB in Portugal, the State itself also assumes a fundamental and direct role in the scope of protection and reparation of the damages to the injured parties of accidents at work and their legal beneficiaries.

This is done through the "Fundo de Acidentes de Trabalho" (FAT) created for promoting eminently social purposes in the contest of Workers Compensation. The FAT became the mechanism by which the State becomes the guarantor in situations that the insurance market, per se, does not cover.

The FAT, in any case, is considered an expense for insurance companies: the FAT is partially funded directly by them through a percentage on the amount corresponding to the redemption capital of pensions running at the end of each year (mathematical provisions).

The Workers compensation LoB comprises two groups of benefits:

- Medical, surgical, pharmaceutical, hospital and any other assistance, including expenses for accommodation, transport, prostheses in so far as they are necessary to restore the injured person's state of health and working and earning capacity, and their functional rehabilitation.
  These type of claims are of the following nature: uncertain in its timing and frequency, so, the underlying risk is not the mortality or survival of the beneficiary resulting in a obligation analysed with NSLT techniques.

- Life annuity for reduced working or earning capacity; supplementary allowance for assistance by a third person; allowances for high permanent incapacity, for re-adaptation to housing and for death and funeral expenses; pensions for members of the family for the death of the injured person.
  The amount of these claims is pre-defined and the uncertainty comes from the survival of the individual resulting on a type of obligation that is managed with Life Techniques within the Actuarial practice.

The next chapter will be more focused in the second type of benefits.

4.1. Best estimate for WC SLT liabilities

The BE, under SII, for life insurers obligations should be calculated for each policy, projecting the cash flows separately. However, in order to facilitate the process, it is possible to aggregate homogenous risk groups together, obtaining a good approximation for the calculation of the BE.

For IFRS17 implementation, due to the similarity of the concepts with SII, the calculation method remained unchanged.

The calculation of the degree of disability and the respective annual pension, in *"SLT annuity model"*, is considered as an input defined, case by case, by "Portaria_Lei_98_2009". For this reason, I will analyse, from a theoretical point of view, the different cases even though they are not explicitly calculated in the SLT project.

SLT liabilities are divided into two categories:

- Pensions divided into:
    - For permanent disability
    - For Dependants in case of death of the insured
- Life time assistance

It is important to remember that some pensions are redeemable: this aspect will be analysed, in more details in the following paragraphs.

4.2. Pensions

i. Non-redeemable pensions

The capital compensation and the pension for permanent incapacity and the allowance for high permanent incapacity are benefits intended to compensate the injured person for the loss or permanent reduction of his capacity to work or gain resulting from an accident at work.

Depending on the seriousness of the disability there may be different benefits

- Absolute permanent incapacity for any work - annual and lifelong pension equal to 80% of salary, plus 10% of salary for each dependant
- Absolute permanent incapacity for normal work - annual and lifelong pension equal to between 50% and 70% of salary, depending on the residual functional capacity to exercise another compatible work
- Partial permanent incapacity - annual and lifelong pension equal to 70% of the reduction suffered in the general capacity to earn
- Absolute temporary incapacity - daily compensation equal to 70% of the salary for the first 12 months and 75% for the following period

For Dependants in case of death of the insured:

- Spouse or unmarried partner - 30 % of the injured person's salary until reaching retirement age and 40 % from that age or from a disability or chronic illness which significantly affects their ability to work

- Descendants - 20 % of the injured person's salary if only one, 40 % if two, 50 % if three or more, and twice these amounts, up to a maximum of 80 % of the injured person's salary if they were orphans of both parents.

- Ascendants- 10 % of the injured person's salary for each, and the total pensions shall not exceed 30 % of that salary. In absence of other beneficiaries they will receive 15% of the injured person's salary until they reach the retirement age due to old age, and 20% from this age or in the case of disability or chronic illness that significantly affects their ability to work.

- FAT-if there are no beneficiaries entitled to a pension, a sum equal to three times the annual salary is paid into the Industrial Accidents Fund.

ii. Redeemable pensions

Some pensions could be "redeemable" (paid as a lump sum) if the following conditions are fulfilled:

- A pension is compulsory redeemable if the injured person has permanent partial incapacity of less than 30 % and the value of the annual pension is not more than six times the value of the minimum monthly guaranteed salary in force on the day following the date of discharge or death.

- A pensions may be partially redeemed by the request of the injured person or the legal beneficiary if the injured person has permanent partial incapacity of more than 30% provided the following limits are respected:

  - The remaining annual pension may not be less than six times the minimum monthly guaranteed salary in force on the date the redemption is authorised

  - The redemption capital may not exceed that which would result from a pension calculated on the basis of a 30 % incapacity

The redeemable pension value will be obtained by the following formula:

1) $RPV = Annual\ pension\ value * redemption\ factor$

Where the Annual pension value is obtained case by case defined before, while the redemption factor is established by law in *Portaria* no 11/2000 left in the annex.

4.3. Lifetime assistance

Lifetime care includes a set of benefits to compensate the worker incapacitated due to an accident. These benefits may include: medical expenses, prostheses, changes of implanted medical devices, hospitalization, and so on.

The benefits listed above may change depending on the health status of the worker; they usually tend to be higher in the early stages and then decrease as the worker improves. Due to this and to the non-constant frequency of payments, the calculation of BE is not easy to achieve.

4.4. SLT Annuity Model assumptions

As we have seen before, contracts belonging to Lob Workers Compensations can generate two types of claims (NSLT, SLT) which must be treated with the methods mentioned above.

Once the claim happens the claim can be classified as a Non-life type of claim or Life type of claim: the person may just need hospital and any other assistance but, in more serious cases, a disability pension or life assistance may be required.

In our *SLT Annuity Model* we analysed claims that are to be managed with Life techniques (SLT). For this reason our focus is on LIC rather than LRC. (We are also considering the duration of the contract is for one year).

The LIC is characterized just by Outflows only and not Inflows: we are projecting only payments for benefits (pension), Capital (for Redeemable pensions) and associated expenses.

In the LIC, it must be remembered that the only model available is the GMM which requires the calculation of FCF but not of the CSM.

The image below will summarise this concept:

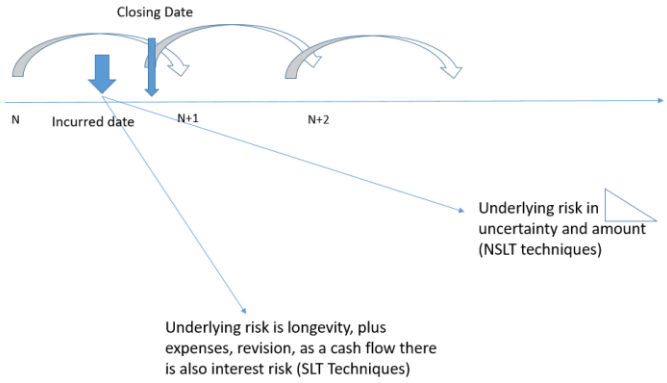

Figure 10 - Brief description of 1 year renewable insurance contract for WC

4.5. Calculation of IFRS 17 Longevity shock using Lee-Carter model

This paragraph will analyse the theoretical aspects that link the Shocks in SII and IFRS 17.

In particular, it will be shown how it is possible to obtain the shock for Longevity Risk in IFRS 17 starting from the knowledge of SII: to do this use the Lee-Carter model assumptions will be used.

i. SII Shocks

It is important to remember that in our analysis we are focusing on liabilities that are calculated based on certain scenarios of the risk factors underlying this type of obligation, i.e., in the case of Health SLT in Solvency II, what is considered to be underwriting risk (longevity, revision and expense). In fact, in our study, we are going to derive the calculation of the IFRS17 Longevity shock based on the approach proposed by the SII for the analysis of the risks inherent in these obligations.

Under the Solvency II Standard Formula calculation, a stress test and correlation approach is used, where the stress tests and correlations are calibrated by EIOPA. Under this approach, we have first to compute the present value of future cash flow, the so called BE in a Central scenario. The calculation will be repeated with the margins added to different assumptions (Stress Scenarios) left in Appendix B.

Under IFRS17, stresses are no longer defined by IASB and do not represent the volatility over one year but need to cover the volatility over the full horizon of the projections. Shocks are no longer fixed but they vary with time (they are projected), as shown in paragraph 4.6.

The differences between the stressed runs and the central run are used to compute, what in Solvency II it is considered the SCR and in our IFRS17 approach, the marginal RA which are then aggregated using a correlation matrix so obtain what in Solvency II is the total Health SLT Underwriting Risk and in IFRS17 the Health SLT total Risk Adjustment.

ii. Lee-Carter model

The Lee-Carter method of forecasting mortality combines a demographic model of mortality with time-series method of forecasting. The usual formula is:

(1) $\ln\big(u(x,t)\big) = a_x + B_x K_t + \varepsilon_{x,t}$

Where:

$u(x,t)$- central mortality rate at age x in year t

a_x- describes the general shape of mortality at age x

K_t- measures how mortality evolve with time

B_x –measures the change in the rates in response in the underlying time term in the level of mortality K_t

$\varepsilon_{x,t}$- Independently distributed normal random variables with mean 0 and some variance to be estimated.

The Lee-Carter model requires, in order, to estimate the parameters a_x, B_x, K_t, some constraints need to be imposed:$\sum_x B_x$=1, $\sum_t K_t$=0

One approach to forecast the parameter K_t is through time series methods using a random walk on the differences K_t series ARIMA (0,1,0) like in the below formula:

$$(2)\ K_t = K_{t-1} + C + \sigma\varepsilon_t$$

Where $\varepsilon_t \approx N(0,1)$

From equation (2) we can obtain from recursion the next equation

$$(3)\ K_t = K_0 + C.t + \sigma\sum_{k=1}^{t}\varepsilon_k$$

And the quantile of the log rate is (substituting (3) in (1)):

$$q_a(\ln(u(x,t))) = q_a(a_x + B_x(K_0 + C.t + \sigma\sum_{k=1}^{t}\varepsilon_k)$$

We can take it from the quantile everything is not stochastic and we obtain:

$$q_a(\ln(u(x,t))) = (a_x + B_x(K_0 + C.t + \sigma q_a(\sum_{k=1}^{t}\varepsilon_k))$$

Where $q_a(\sum_{k=1}^{t}\varepsilon_k)) = \sqrt{t}.q_a$

because: $(\sum_{k=1}^{t}\varepsilon_k) \approx N(0,t)$ (i.i.d), so $\frac{1}{\sqrt{t}} * (\sum_{k=1}^{t}\varepsilon_k) \approx N(0,1)$

$$q_a(\ln(u(x,t))) = a_x + B_x(K_0 + C.t + \sigma\sqrt{t}.q_a(\frac{1}{\sqrt{t}} * \sum_{k=1}^{t}\varepsilon_k)$$

Finally we obtain eq (4)

$$(4)\ q_a(\ln(u(x,t))) = a_x + B_x(K_0 + C.t + \sigma\sqrt{t}.q_a)$$

iii. IFRS 17 shocks calculation

With the results obtained above it is possible to write the IFRS17 stress for mortality at time t and confidence level α with the following formula:

$$(5)\ \Delta_{x,t}^{IFRS} = \frac{q_a(\ln(u(x,t)) - E(\ln(u(x,t))}{E(\ln(u(x,t))}$$

Substituting (4) in (5) and knowing that $E(\ln(u(x,t)) = a_x + B_x(K_0 + C.t)$ due the fact that $E(\sum_{k=1}^{t}\varepsilon_k) = 0$

Then we can obtain the following equation:

$$(6)\ \Delta_{x,t}^{IFRS} = \frac{B_x\,\sigma\sqrt{t}\,q_a}{a_x + B_x\,(k0 + C*t)}$$

It is possible, using formula (5) also for SII shocks: remembering that in these values are already defined by EIOPA (β=99.5%)

(7) $\Delta_{x,t}^{SII} = \frac{a_x + B_x.(k_0 + C.t + \sigma.q_B)) - E(ln(\mu(x,t)))}{E(ln(\mu(x,t)))}$

Using this result in equation (7) we obtain the following equation:

(8) $\Delta_{x,t}^{SII} = \frac{B_x.\sigma.q_\beta}{a_x + B_x*(K_0 + C*t)}$

It is now quite easy looking at the differences between IFRS 17 and SII shocks: Substituting eq. (8) into (6) we obtain:

(9) $\Delta_{x,t}^{IFRS} = \frac{q_a}{q_\beta} * \sqrt{t} * \Delta_{x,t}^{SII}$

Where:

q_a- Is the quantile for the confidence level a of the standard normal distribution for IFRS 17

q_β – is the quantile for the confidence level β of the standard normal distribution for SII

t- is the time when the shock applies

$\Delta_{x,t}^{SII}$ – is the standard SII shock

From equation (9), it is possible to see that the shocks in the IFRS 17 framework evolve with time. Like shown in the image below (example for a=75% and β=99.5%), the adjustment factor $\frac{q_a}{q_\beta} * \sqrt{t}$ is:

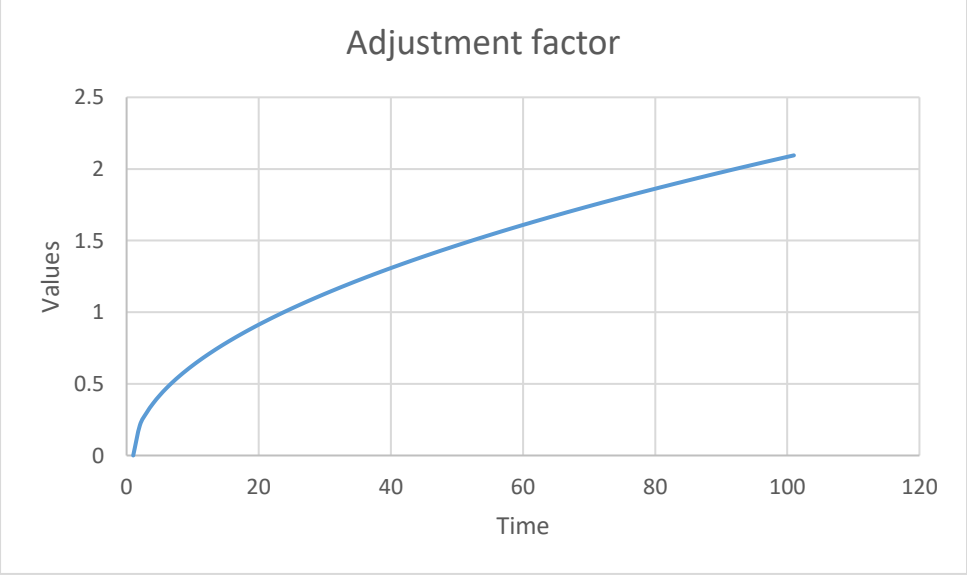

Figure 11- Evolution of IFRS17 Adjustment Factor with time [11]

This eq (9) will be used in case study to calculate the RA in IFRS 17. After having computed the shock it is possible to obtain the Marginal RA

[11] Addactis®. (June 2019)*Volada_Paper_Addactis_IFRS_17_Risk_Adjustment*

4.6. Marginal RA and RA Aggregation

In the chapter above, we have seen how to use the theory behind stochastic mortality models (Lee-Carter) to compute the new IFRS 17 shocks.

In more general way, it is possible extend that approach to other non-financial risks presented in the SLT model (expenses, revision) if some conditions are fulfilled. In more general we can define the following formula:

(10) $$RA_i = BE_i^{IFRS17} - BE$$

Where:

BE_i^{IFRS17} – Is the BE IFRS 17 stressed for a risk i

BE – Is the BE Central (not stress applied)

After calculating the Marginal RA, the Aggregation of them is required. Different approaches can be used to do that: Here we will present the two most common aggregation techniques:

- **Correlation matrices**: can be used to estimate the aggregate RA. Choosing the correlation factors, the entity would consider the confidence level of the risk exposure and make sure that the correlation still applies at that level of confidence.

One advantage of this method is the simplicity of calculation and easy understanding. On the other hand, a single matrix estimating all the corrections may not be adequate for a particular company.
This is the case of SII matrix where the parameters are already established by EIOPA and could be incorrect in some circumstances.

- **Copulas**: An actuary could decompose the joint probability distributions into marginal probability distributions and a Copula that link them and allow to quantify the correlations between risks.

  This method can be very useful, in particular, in case of catastrophic scenarios where linear correlation may not properly capture the risk dependency. On other ways, they require a solid mathematical knowledge and could not be comprehensive and easy to explain.

The consolidate RA computed in the next chapter, is obtained through the first method (SII correlation matrix) and the following formula:

(11) $$RA = \sqrt{R' \sum R}$$

Where:
R - is the vector of the marginal risk adjustements
$\sum$ - is the standard SII matrix

4.7. Modeling: Analysis and results

This part implements, in practice, what we have seen in the precedent paragraphs: the assumptions of the *"SLT annuity models"*, analysed in paragraph 4.4 will be useful to a better understanding of this part.

In the previous paragraph, we have seen how it is possible to use the Lee-Carter method to obtain the Longevity shock for IFRS17.
It is important to precise that in the tables below, the RAs marginal of the other shocks will be shown for practical purposes. For these ones, we have decided to use the same methodology for the longevity shock, although they are, however, the subject of more in-depth study.

The values chosen for IFRS17 and SII quantiles (q_α , q_β) are 0.75 and 0.995 respectively, as can be seen from the table 2:

TABLE 2 - SII & IFRS17 CONFIDENCE LEVEL

Risk	SII_Percentile	IFRS17_Percentile
Quantile	0.995	0.75

Tables 3 shows the marginal RAs obtained with Top-Down approach (at a more general level) while table 4 shows the aggregate RA (obtained with SII matrix).

TABLE 3 - MARGINAL RAS

Risks	Gross
Revision	120,863.06
Expenses	22,614.11
Longevity	185,084.00

TABLE 4 - RA AGGREGATON

LoB	Aggregate
SLT	255,707.33

Finally, table 5 shows the results obtained with the "Bottom-up" approach and compare with the other methodology. All the tables are taken at present value (projection 0).

TABLE 5 - RA SUMMARY TABLE

GoC	RA_Longevity	RA_Expenses	RA_Revision	RA_Total	RA_Total_Diversified_RAR	RA_Total_Diversified_BER
Workers' Compensation SLT - Annuities - 1998 - Profitable	27,857.39	3,651.16	20,468.94	40,237.29	39,892.12	77,074.84
Workers' Compensation SLT - Annuities - 1999 - Profitable	44,105.41	2,815.27	15,950.38	51,636.87	51,193.91	37,872.35
Workers' Compensation SLT - Lifetime Assistance - 1997 - Profitable	57,134.85	8,489.92	44,776.28	85,107.05	84,376.98	74,291.04
Workers' Compensation SLT - Lifetime Assistance - 1998 - Profitable	8,427.90	1,247.28	6,581.68	12,534.11	12,426.58	10,929.60
Workers' Compensation SLT - Lifetime Assistance - 1999 - Profitable	27,232.32	2,051.09	11,496.36	32,954.77	32,672.07	22,394.46
Workers' Compensation SLT - Lifetime Assistance - 2000 - Profitable	11,102.89	2,512.33	12,409.20	19,939.56	19,768.51	18,893.69
Workers' Compensation SLT - Lifetime Assistance - 2001 - Profitable	9,223.24	1,847.06	9,180.21	15,510.20	15,377.15	14,251.35
Total	**185,084.00**	**22,614.11**	**120,863.06**	**257,919.84**	**255,707.33**	**255,707.33**

With reference to Table 5, the following concepts are present:

- **GoC:** it refers to the Group of contract associated with every policy. What is required for the definition of GoC is the LoB (Workers's compensation SLT), the kind of SLT product (Annuities, life time assistance) and the year of occurrence.
- **RA_Longevity**: is the longevity RA obtained with formula (10)
- **RA_Expenses**: is the Expenses RA obtained with formula (10)
- **RA_Revision**: is the Revision RA obtained with formula (10)
- **RA_Total:** Is the aggregated RA obtained with the "Bottom-up" approach, directly at "*GoC"* level with formula (11).

- **RA:Total_Diversified_RA**: Is splitting the results obtained the at aggregate level into the Group of contracts using the Risk adjustment as a scalar allocation. The results obtained here a lower than the values of the RA directly computed at the GoC level. The degree of diversification due of Group of contracts is taken into the account.

- **RA:Total_Diversified_BER:** Is splitting the results obtained the at aggregate level into the Group of contracts using the present value of future cash flows as a scalar allocation.

  This method, in this case, leads to different results, in particular it increases the allocated RA in the contract groups where the proportion of BE in the whole portfolio is bigger.

5. CONCLUSIONS

The objective of this research was to seek a practical and effective response to the many questions that the new IFRS17 standard requires in terms of modeling and valuation of Insurance contracts liabilities.

Indeed companies that operate in the Workers' Compensation LoBs will face significant challenging in the implementation of this new standard. Our approach to cover the Risk Adjustment requirement in the SLT part seems to provide a practical solution to a complex problem. But also these companies will need to face difficult calculations in the computations of Future cash flows and RA at the level of granularity required for NSLT type of claims.

The development of this model was made possible thanks to the many readings and questions that we asked along the way. Fundamental was the reading of articles and books available online as well the discussion with PhD students and qualified people.

Regarding the vastness of the topic, it was not easy to choose the most relevant arguments without falling into digressions, perhaps interesting, but not relevant to the purpose of this research.

I would like to say that the development of our model is still being updated, and we frequently stop and think about how we can improve it, through the feedback from our clients.

Through this study, I understand how many practical challenges IFRS17 poses on insurance companies and how much work is needed in an often limited time.

Finally, I want to focus on possible improvements that could be implemented in the future:

The correlation matrix for SLT risks is however static, the idea would be to have the coefficients of the matrix change over time (this could be done through a projected matrix or through the use of copulas).

A more in-depth study of the risks for Expense (including inflation) and Revision, at the moment we are using a correct method for Longevity risk but we are not yet sure of the goodness of the choice for the other types of risk.

APPENDIXES

Appendix A- Pensions redeemable factors

ANEXO

Tabelas

Pensionistas de ambos os sexos (exceptuando os casos seguintes)

Idades	Taxas	Idades	Taxas	Idades	Taxas
10	18,426	44	14,851	78	5,992
11	18,369	45	14,664	79	5,697
12	18,309	46	14,470	80	5,407
13	18,246	47	14,270	81	5,123
14	18,181	48	14,063	82	4,853
15	18,113	49	13,851	83	4,592
16	18,044	50	13,636	84	4,339
17	17,974	51	13,416	85	4,097
18	17,905	52	13,192	86	3,863
19	17,838	53	12,964	87	3,636
20	17,770	54	12,732	88	3,423
21	17,701	55	12,496	89	3,228
22	17,629	56	12,259	90	3,043
23	17,555	57	12,016	91	2,864
24	17,476	58	11,769	92	2,697
25	17,393	59	11,518	93	2,547
26	17,305	60	11,264	94	2,401
27	17,213	61	11,006	95	2,256
28	17,116	62	10,745	96	2,096
29	17,013	63	10,478	97	1,940
30	16,906	64	10,207	98	1,760
31	16,794	65	9,929	99	1,636
32	16,677	66	9,645	100	1,526
33	16,555	67	9,352	101	1,421
34	16,428	68	9,055	102	1,307
35	16,296	69	8,754	103	1,195
36	16,158	70	8,450	104	1,039
37	16,015	71	8,141	105	0,813
38	15,866	72	7,834	106	0,542
39	15,711	73	7,527	–	–
40	15,550	74	7,218	–	–
41	15,383	75	6,908	–	–
42	15,211	76	6,601	–	–
43	15,032	77	6,294	–	–

Ascendentes de acordo com o n.º 2 do artigo 20.º da Lei n.º 100/97, de 13 de Setembro

Idades	Taxas	Idades	Taxas	Idades	Taxas
14	18,365	48	15,192	82	4,853
15	18,307	49	15,046	83	4,592
16	18,248	50	14,900	84	4,339
17	18,189	51	14,756	85	4,097
18	18,132	52	14,612	86	3,863
19	18,077	53	14,471	87	3,636
20	18,022	54	14,332	88	3,423
21	17,966	55	14,197	89	3,228
22	17,909	56	14,068	90	3,043
23	17,850	57	13,943	91	2,864
24	17,787	58	13,821	92	2,697
25	17,721	59	13,708	93	2,547
26	17,651	60	13,602	94	2,401
27	17,577	61	13,507	95	2,256
28	17,499	62	13,421	96	2,096
29	17,418	63	13,348	97	1,940
30	17,333	64	13,287	98	1,760
31	17,244	65	9,929	99	1,636
32	17,151	66	9,645	100	1,526
33	17,055	67	9,352	101	1,421
34	16,955	68	9,055	102	1,307
35	16,852	69	8,754	103	1,195
36	16,744	70	8,450	104	1,039
37	16,633	71	8,141	105	0,813
38	16,518	72	7,834	106	0,542
39	16,399	73	7,527	–	–

Idades	Taxas	Idades	Taxas	Idades	Taxas
40	16,276	74	7,218	–	–
41	16,149	75	6,908	–	–
42	16,020	76	6,601	–	–
43	15,887	77	6,294	–	–
44	15,754	78	5,992	–	–
45	15,618	79	5,697	–	–
46	15,479	80	5,407	–	–
47	15,337	81	5,123	–	–

Órfãos até ao máximo de 25 anos de idade

Idades	Taxas	Idades	Taxas	Idades	Taxas
0	13,968	9	10,914	18	5,871
1	13,797	10	10,460	19	5,158
2	13,503	11	9,983	20	4,406
3	13,190	12	9,481	21	3,615
4	12,859	13	8,952	22	2,781
5	12,509	14	8,396	23	1,903
6	12,141	15	7,812	24	0,976
7	11,753	16	7,197	–	–
8	11,344	17	6,550	–	–

Cônjuge ou pessoa em união de facto, de acordo com a alínea *a*) do n.º 1 do artigo 20.º da Lei n.º 100/97, de 13 de Setembro

Idades	Taxas	Idades	Taxas	Idades	Taxas
14	11,926	48	14,425	82	4,853
15	11,528	49	14,373	83	4,592
16	11,110	50	14,312	84	4,339
17	10,672	51	14,241	85	4,097
18	10,213	52	14,163	86	3,863
19	9,940	53	14,080	87	3,636
20	9,755	54	13,992	88	3,423
21	9,651	55	13,901	89	3,228
22	9,619	56	13,812	90	3,043
23	9,655	57	13,721	91	2,864
24	9,754	58	13,631	92	2,697
25	9,914	59	13,545	93	2,547
26	10,129	60	13,463	94	2,401
27	10,396	61	13,389	95	2,256
28	10,707	62	13,323	96	2,096
29	11,053	63	13,267	97	1,940
30	11,420	64	13,222	98	1,760
31	11,797	65	9,891	99	1,636
32	12,169	66	9,615	100	1,526
33	12,518	67	9,330	101	1,421
34	12,836	68	9,040	102	1,307
35	13,125	69	8,745	103	1,195
36	13,396	70	8,445	104	1,039
37	13,642	71	8,141	105	0,813
38	13,852	72	7,834	106	0,542
39	14,028	73	7,527	–	–
40	14,172	74	7,218	–	–
41	14,285	75	6,908	–	–
42	14,371	76	6,601	–	–
43	14,430	77	6,294	–	–
44	14,469	78	5,992	–	–
45	14,486	79	5,697	–	–
46	14,483	80	5,407	–	–
47	14,462	81	5,123	–	–

Observação. — Na aplicação das tabelas práticas, toma-se a idade correspondente ao aniversário mais próximo da data a que se referem os cálculos.

Appendix B- SII SLT Correlation Matrix

Life Stresses

Risk	Stress
Mortality	0.15
Longevity	-0.2
Expense	0.1
Cat	0.0015
Lapse Up	0.5
Lapse Down	-0.5
LapseMass	0.4
Expense_infl	0.01
Revision	0.04

Appendix C- SII Contract Boundary Regulation

"All obligations relating to the contract, including obligations relating to unilateral rights…to renew or extend the scope of the contract and obligations that relate to paid premiums… unless otherwise stated…[in later paragraphs].

Obligations which relate to… cover provided… after any of the following dates do not belong to the contract, unless the undertaking can compel the policyholder to pay the premium for those obligations:

a) The future date where the insurance or reinsurance undertaking has a unilateral right to terminate the contract;

b) The future date where the insurance or reinsurance undertaking has a unilateral right to reject premiums payable under the contract;

c) The future date where the insurance or reinsurance undertaking has a unilateral right to amend the premiums or the benefits payable under the contract in such a way that the premiums fully reflect the risks.

Obligations that do not relate to premiums which have already been paid do not belong to an insurance or reinsurance contract, unless the undertaking can compel the policyholder to pay the future premium, and where all of the following requirements are met:

a) The contract does not provide compensation for a specified uncertain event that adversely affects the insured person;

The contract does not include a financial guarantee of benefits[12]."

[12] IFRS17 CSM Working Party. (November, 2019*). Determining contract boundary under IFRS17*

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